

**IMMOBILIZATION OF MESOPOROUS-ASSEMBLED TiO<sub>2</sub>  
NANOCRYSTAL PHOTOCATALYST FOR DEGRADATION  
OF AZO DYE CONTAMINANT IN WASTEWATER**



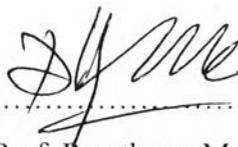
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**Thesis Title:** Immobilization of Mesoporous-Assembled TiO<sub>2</sub> Nanocrystal  
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Wastewater  
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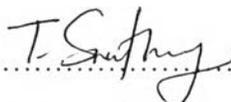
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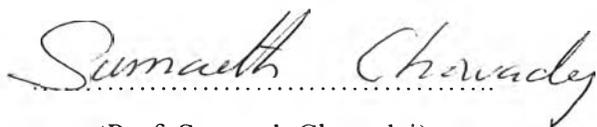


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## ABSTRACT

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Pavita Kunwanlee: Immobilization of Mesoporous-Assembled TiO<sub>2</sub> Nanocrystal Photocatalyst for Degradation of Azo Dye Contaminant in Wastewater

Thesis Advisors: Asst. Prof. Thammanoon Sreethawong and Prof. Sumaeth Chavadej 81 pp.

Keywords: Mesoporous TiO<sub>2</sub>/ Photocatalysis/ Immobilization/ Azo Dye/ Acid black/ Degradation

Photocatalysis is an advanced oxidation process that efficiently degrades organic contaminants present in wastewater effluents. The suspension of TiO<sub>2</sub> powders in wastewater during the photocatalytic treatment shows great photoactivity, but it requires further troublesome filtering process to separate the photocatalyst from the treated wastewater. Therefore, utilization of TiO<sub>2</sub> in an immobilized mode is more practical because it solves the problems of TiO<sub>2</sub> separation and reuse as compared to a suspension mode. This work focused on the photocatalytic degradation of Acid Black (AB) diazo dye by using nanocrystalline mesoporous-assembled TiO<sub>2</sub> photocatalyst immobilized on a glass plate, where the mesoporous-assembled TiO<sub>2</sub> nanocrystal was synthesized by a sol-gel process with the aid of a structure-directing surfactant. Various preparation parameters during the immobilization step were investigated on the photocatalytic AB dye degradation performance. The experimental results showed that the mesoporous-assembled TiO<sub>2</sub> film with 5 wt.% P-25 TiO<sub>2</sub> addition and calcined at 400 °C provided the highest AB dye degradation rate constant of 0.23 h<sup>-1</sup>. Moreover, an increase in the number of coated TiO<sub>2</sub> layers was found to enhance the photocatalytic activity until reaching the peel-off limitation at 4 layers.

## บทคัดย่อ

ภาววิดา วรรณวัลลี : การสลายตัวของสีย้อมประเภทเอโซที่ปนเปื้อนในน้ำเสียโดยใช้ตัวเร่งปฏิกิริยาแบบใช้แสงร่วมไททาเนียที่มีโครงสร้างในลักษณะนาโนและมีรูพรุนในระดับเมโซพอร์ซึ่งถูกตรึงบนตัวรองรับ (Immobilization of Mesoporous-Assembled  $\text{TiO}_2$  Nanocrystal Photocatalyst for Degradation of Azo Dye Contaminant in Wastewater) อ. ที่ปรึกษา : ผศ.ดร. ธรรมณูญ ศรีทะวงศ์ และ ศ.ดร. สุเมธ ชวเดช 81 หน้า

ปฏิกิริยาแบบใช้แสงร่วมเป็นกระบวนการออกซิเดชันที่มีประสิทธิภาพ สำหรับการย่อยสลายสารอินทรีย์ที่ปนเปื้อนในน้ำเสีย การใช้ผงไททาเนียแบบแขวนลอยในน้ำเสียระหว่างปฏิกิริยาแบบใช้แสงร่วมนั้นสามารถตอบสนองต่อความไวแสงได้ดี แต่จะก่อให้เกิดปัญหาในกระบวนการแยกตัวเร่งปฏิกิริยาแบบใช้แสงร่วมจากน้ำเสียที่บำบัดแล้ว ดังนั้นการนำไททาเนียที่ตรึงบนตัวรองรับแล้วมาใช้จะมีความเหมาะสมมากกว่า เนื่องจากสามารถแก้ไขปัญหของกระบวนการแยกไททาเนีย และสามารถนำกลับมาใช้ได้ใหม่ ในงานวิจัยนี้มุ่งเน้นศึกษาความสามารถในการย่อยสลายสีย้อมประเภทไดเอโซชนิดแอซิดแบล็คของตัวเร่งปฏิกิริยาแบบใช้แสงร่วมไททาเนียที่มีโครงสร้างในลักษณะนาโนและมีรูพรุนในระดับเมโซพอร์ ซึ่งถูกตรึงบนแผ่นกระจกใส ในการทดลองนี้ตัวเร่งปฏิกิริยาที่มีโครงสร้างในลักษณะนาโนและมีรูพรุนในระดับเมโซพอร์สังเคราะห์ขึ้น โดยกระบวนการ โซล-เจลร่วมกับการใช้สารลดแรงตึงผิวเป็นตัวกำหนดโครงสร้าง โดยได้ทำการศึกษาดูแปรต่างๆ ในขั้นตอนการตรึงตัวเร่งปฏิกิริยา เพื่อใช้ในปฏิกิริยาแบบใช้แสงร่วมในการสลายตัวของสีย้อมแอซิดแบล็ค จากผลการทดลองพบว่าเมื่อใส่ตัวเร่งปฏิกิริยาแบบใช้แสงร่วมไททาเนียเกรดทางการค้า พี-25 ปริมาณ 5 เปอร์เซ็นต์โดยน้ำหนัก ลงบนฟิล์มตัวเร่งปฏิกิริยาไททาเนียที่มีโครงสร้างในลักษณะนาโนและมีรูพรุนในระดับเมโซพอร์ ซึ่งเผาที่อุณหภูมิ 400 องศาเซลเซียส ให้ผลในการย่อยสลายสีย้อมแอซิดแบล็คดีที่สุด โดยแสดงอัตราการฟอกสีที่ 0.23 ต่อชั่วโมง นอกจากนี้ยังพบว่า การเพิ่มจำนวนชั้นของฟิล์มตัวเร่งปฏิกิริยาไททาเนียช่วยทำให้เกิดปฏิกิริยาแบบใช้แสงร่วมได้ดีขึ้นจนกระทั่งเพิ่มจำนวนชั้นไปถึงจุดที่ฟิล์มไททาเนียเกิดการหลุดลอกออกซึ่งจำกัดอยู่ที่ 4 ชั้น

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